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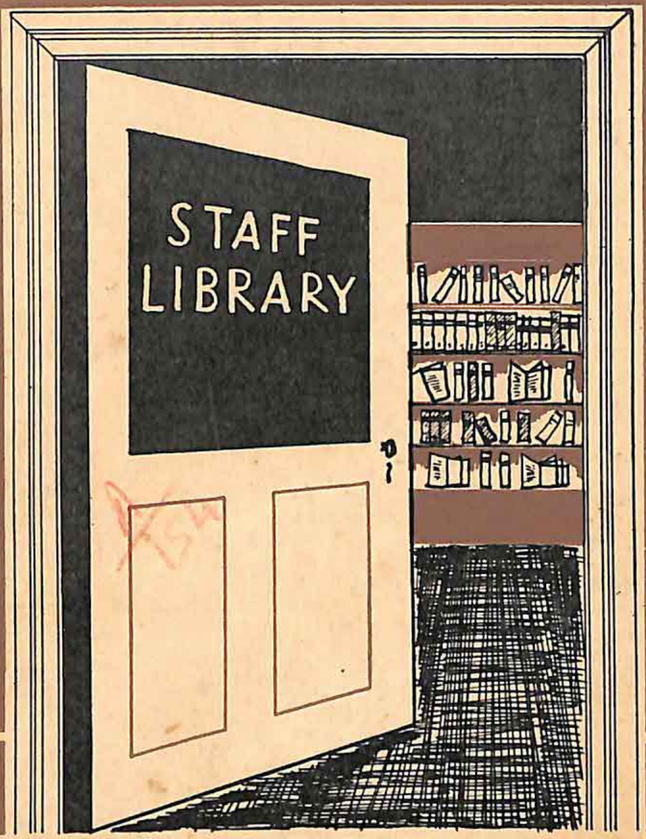

# TEACHING NATURE STUDY

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# TEACHING NATURE STUDY

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BY

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# *PART I*

# WHY WE TEACH NATURE STUDY

## § 1. AIMS

The first aim of Nature Study is to *encourage the children's natural interest in plants and animals.* Many children know far too little about the living things around them. We must open their eyes and minds so that they start to look at, and to think about, the many living things which they see every day.

The second aim of Nature Study lessons is to teach the children *to observe*, remember and collect facts and opinions, *to record* them by drawing and by writing and then to sort and arrange these ideas, so that they learn *to think clearly*. This aim is not concerned so much with the knowledge gained as with the way in which it is gained and the development of a sensible attitude to learning and problems.

The third aim is *to help the pupils in their everyday lives.* This is the practical aim of teaching Nature Study. For example, the facts and principles of Nature Study are taught because they can help us to grow bigger and better crops and to look after the soil. Knowledge of the lives of flies, mosquitoes, beetles, and so on, helps children to understand how to control these insects so that they can help in keeping their village or town healthy. We should try to prevent ignorance and superstition affecting the daily lives of the children and their attitude towards Health, Agriculture and the world around them.

The fourth and last aim is *to encourage interests and hobbies* among children, so that some of them will spend their leisure wisely in enjoying the beauty of nature. A few children will become very keen and spend all of their free time watching birds, collecting butterflies, and rearing fish and so on. Nature Study is a practical subject that makes use of hands and brains and it gives pleasures and satisfactions that cannot come from books alone.

## § 2. WAYS OF TEACHING

### (i) The Telling Way

Most teachers think that there is a large place for this method in their lessons. Facts that are not easy to observe, or take too long to observe, or need special apparatus, can be told to the children by the teacher. Many facts about soil and agriculture must be told to the children. Similarly, no teacher can expect a child to discover the cause and cure for malaria, the best way of growing plants from stems, and so on.

However, only a bad teacher would use the telling method when teaching about the parts of a cockroach or grasshopper, the shapes of leaves, the parts of flowers, and so on. These things can best be found out by the pupils themselves. A safe rule to follow is never to use this method if another one can be used and is not too difficult.

### (ii) The Discovery Way

By this way the pupils gain knowledge by their own actions and discoveries. For example, you do not tell the children about the shapes of leaves, as you would in the telling way of teaching. Instead you ask them to collect many common leaves and then allow them to discover for themselves as much as they can about the shapes. Similarly, questions about insects are not answered by a statement from the teacher; instead, insects such as grasshoppers, cockroaches, moths, butterflies and so on are examined by the class and the answers found gradually by discovery. The discovery way trains children to look and think, to see with understanding.

A good teacher will use this way of teaching fairly often. Many times when some question is asked he must say "I don't know, but let us find out" or "How can we find out?" A sensible rule is this: if a fact can readily be discovered, then do not tell it; if it is difficult to discover, then teach it by the telling method.

You will find suggestions for this way of teaching in later sections of the book, for example in Sections 12 to 19, where the sort of questions you ask (and, in brackets, your pupils' answers) are suggested for various topics.

## § 3. DIAGRAMS

Much of the pupils' written work should consist of diagrams rather than notes. Do not allow children to copy your diagrams from the blackboard. Their drawings should be made from the real things with the specimens actually in front of them. This is easy to do when making drawings of things like leaves, flowers, earthworms, cockroaches, and other common plants and insects, which can easily be obtained. It is less easy when drawing creatures like scorpions, special kinds of butterfly, and so on. If there is only one specimen, the children have to come up in small groups to examine it, and this method is not good with large classes.

Nature Study diagrams should not be made like drawings done in an art class. Fancy decoration and shading should not be allowed; every line in a drawing should mean something. The use of colour is helpful in primary classes, and it seems to be essential in the best drawings of birds. Do not use colour unless it adds something of value to the drawing. The younger the pupils, the more useful colour can be.

All drawings must have a name or title, and important parts of a drawing must be clearly named. The drawings should be in pencil, the names in pencil or ink. The words look neater if they are printed; they should be placed at the sides of the drawing, with lines drawn from them to indicate the exact part labelled. If there are several drawings on one topic, e.g., germination of bean and maize seeds, life histories of house-fly, butterfly, and frog, etc., put the date on each of the smaller drawings that are part of the complete diagram.

## § 4. PRACTICAL WORK

Nature Study requires a lot of practical work, and all good teachers must do as much of it as they can. Some practical work cannot be done in school hours. Advise the children what to look for outside school and at night time, and allow them to make their drawings and their records at the beginning of the lesson in the school next day.

The following are good rules for practical work:

### Rules for Practical Work

1. Always try the work yourself before doing it in a class for the first time.

2. Make sure that everything is ready before the class comes to you.

3. Try to make every piece of practical work a question leading to an answer. Do not state at the beginning what the result will be; for example, do not state "A cockroach has six legs and four wings; will you now look at them?" The heading of the work should always be a question. "To find out . . ." is far better than "To prove that . . ." The first heading emphasizes that careful observation is

required, the second one merely makes the pupils watch something when they already know the answer.

4. Let pupils do as much as possible of the work. Even in the more difficult experiments they can be called out in turn to help. Demonstration work by the teacher should be done with the class in a group around a table in front of the blackboard so that they can all see easily.

5. Make sure that there is plenty of time to discuss what was done, what happened, and what was shown by the test. If the experiment is written out in note-books, sub-headings should be made, such as:

Aim; What we did; What happened; What was shown.

## § 5. NATURE WALKS

A lot of Nature Study must be done out-of-doors. Teaching of the subject only in classrooms kills interest and lessons are dull. If children are learning about plants and animals, first of all they should see the living things in their natural state. For example, do not describe the bark, branches, and leaves of a tree from a few branches or twigs brought into the classroom; first take the class to look at the tree itself.

As much of the work as possible should be done in gardens and fields. Each class should make at least one nature walk every month. Schools in the big towns may find this is as much as they can do. Schools in country areas should easily make one walk a week.

### Making the Best Use of Nature Walks

1. Go on the walk yourself before taking the class with you. If you wish to see a particular kind of plant or animal, you must know where to find it; do not set out to look for it with a class of forty.
2. Explain the object of the walk in a lesson before you go. Do not see too many things and collect too many specimens on one walk.
3. Make sure to discuss the walk after it is over. Do this on the same or the next day, while everyone remembers what they saw.
4. Repeat each walk two or three times during the year, covering exactly the same ground but of course observing different things. On the second and third times the children are more likely to devote themselves to the object of the walk and less likely to look at anything and everything they see.
5. The teachers in the school should plan their walks so that the children cover the whole district around their school and see all living things that are worth knowing.

## § 6. NATURE CORNER

Every classroom in which Nature Study is taught should have its Nature Corner, with a table on which specimens can be shown; a suitable size for the table is about 5 ft. long, $2\frac{1}{2}$ ft. wide, and $2\frac{1}{2}$ ft. tall. The table can be flat or have a rim three or four inches high round its edge. The rim helps to stop things being blown off or knocked off and also stops live creatures (for example, millipedes, earthworms, and small animals) walking off when they are being observed by the class. Help the children to make clear labels for everything that is on the table. If the labels are dated and have the children's signatures, interest will be kept up.

The table should contain only those objects being dealt with in the lessons or which have recently been discussed. The same objects should not be left on the table week after week. You will find in each class one or two children who can keep the table neat and tidy.

## § 7. SPECIMENS

Many Nature Study lessons require specimens of plants and animals. Specimens make the lessons interesting and help the children to understand and remember them. Think of what specimens you will need and make sure they are ready when needed. It is easier to get material for the study of plants than for the study of animals, especially living ones, but if plants are required in the garden or in pots you must take care to plant seeds at suitable times.

When teaching about common objects, such as leaves or flowers, give every pupil a specimen. Ask questions which can only be answered by looking at the specimen. Also try to make sure that all children in the class, and not just a few, are using their eyes and brains. You will have to stop younger children pulling their specimens to pieces at the beginning of the lesson.

Sometimes it is not possible to give a specimen to every pupil, but there may be enough for one to be shared by a small group of children. Train your class to form themselves quickly into groups of three, four or five. The members of a group must learn to share fairly. Stop one child from keeping the specimen and doing all the observation required while the rest of the group does nothing.

Sometimes, especially when studying the larger living animals, there is only one specimen for the whole class. Do not make the beginner's mistake of holding this specimen in front of a class of about forty pupils and then talking as though the children can see every little detail. It is better to call them up in small groups and let them look at the specimen for two or three minutes, while the rest of the class are reading or making notes.

A single specimen can often be used for out-of-lesson observation. Bring it to school either a day before the lesson or before school begins. In a previous lesson tell the children what you want them to look for and write your list on the blackboard so that the children may copy it and remember it. After the children have looked at the specimen in their own time, the actual lesson can be spent discussing things they ought to have seen. Leave the specimen in the classroom for another day, and encourage the children to talk about it.

# *PART II*

# THINGS TO DO WITH PLANTS AND SEEDS

## § 8. SCHOOL GARDEN

Every school should have a garden. Planting seeds, watching them grow, looking after the young plants, are some of the best ways of providing proper training in practical Nature Study. Most of the plants dealt with in the school course should be grown in the garden.

Some schools in the towns may find that they cannot have gardens. They should grow flowers and plants in pots and tins and have them around the school. Most schools will have no trouble in making their gardens. If possible, do not have a fence round the garden unless dogs and other animals destroy your beds and plants. Try to provide a pond in which water plants, fish and water insects can be kept and studied.

## § 9. POTS AND BOXES

Many plants can be grown quite well in pots, boxes or tins. In one way a plant in a pot is better than a plant in a garden because you can carry the pot into the classrooms.

### Preparing the Seed Boxes

Clay pots are best. You will need some small ones, about three inches wide, and some larger ones, up to twelve inches wide. Small wooden boxes are better than pots for some plants. The boxes should be six or eight inches high. Plants can be grown in paraffin oil tins or the large cooking fat tins. Cut one of the tins in two down the middle from top to bottom; in this way you will make two tins. Paint the tins so that they look nice and do not rust quickly. Make eight or nine small holes in the bottoms of the tins. Your pots, boxes and tins are now ready for the soil. Fill them as shown in the diagram.

## § 10. PLANTING SOME SEEDS

The following plants should be grown and studied in the third or fourth primary year:

1. *Maize.* Place three seeds in one twelve-inch pot and cover them with about two inches of soil. When the seeds grow and the plants are about three inches high choose the strongest of the three plants and carefully pull out the other two. In the garden the seeds should be in rows eighteen inches apart, the seeds being two feet apart in the rows. The maize is ready about twelve weeks after planting the seeds.

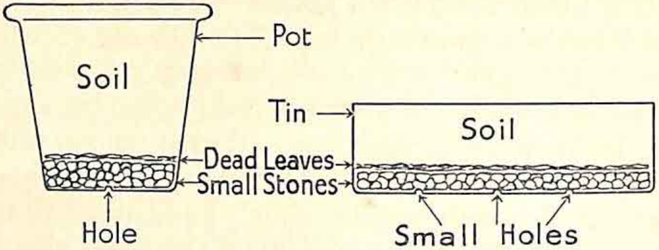

FIG. 1. Pot and Tin ready for seeds

2. *Cow Pea.* Plant two seeds about two inches deep in soil in a large pot. Near the seeds place a wooden stick, three or four feet long, in the pot so that the plant can climb up it. If the seeds are grown in the garden the distance between the plants should be eighteen inches, with eighteen inches between rows. Some peas are ready for picking after seven or eight weeks and others follow in the next few weeks.

3. *Sword Bean.* Grow the seeds in the same way as the Cow Pea seeds, except no sticks are needed to keep up the plant. Some beans are ready three or four months after planting the seeds.

4. *Tomato.* Plant the seeds in boxes or in the garden. Make small holes in the soil and put three seeds in each one. Cover with a little soil. Tomatoes grow best in a sandy soil. The young plants appear in about ten days. When they are about two inches high and have three leaves, move the best plants carefully into another box or part of the garden. In the garden the plants should now be in rows three feet apart and with two feet between plants in a row.

Throw away all weak plants. Cut off or nip off with your fingers all side shoots as soon as you see them; if the side stems grow there will only be small tomatoes on the plant. Flowers start to appear after a few weeks.

5. *Lettuce*. Put the seeds on top of soil in a box and cover with not more than a quarter of an inch of soil. Press it down with your hands and wet it. Keep the box in the shade. As soon as there are three or four leaves on the young plants lift the best ones out of the box, keeping the soil around the roots. Put the plants into holes nine inches apart in another large box or in the garden. Water them and press down the soil. The lettuce is ready about two months after planting the seeds.

6. *Peppers and Chillies*. Grow in boxes and move into the garden when they are about three inches tall. The plants should be two feet apart in the garden. Chillies come after about four months and last about a year. There are many kinds of these plants.

7. *Brinjal or Egg-plant*. Plant the seeds in boxes or in the garden. Keep them in the shade for a few days and give them plenty of water. Move the young plants when they are about three inches high. In the garden they should be two feet apart and with three feet between rows. A good soil and plenty of manure are needed for strong plants to grow.

8. *Ground-nut*. Two seeds should be put in holes about two inches deep and eighteen inches apart, with nine inches between rows. The seeds can be planted in their shells or pods, but they usually grow

better if they are first taken out of the shells. The seeds grow best in sandy soil. The stems grow along the ground and should be kept covered with soil. The nuts are ready about four to five months after planting.

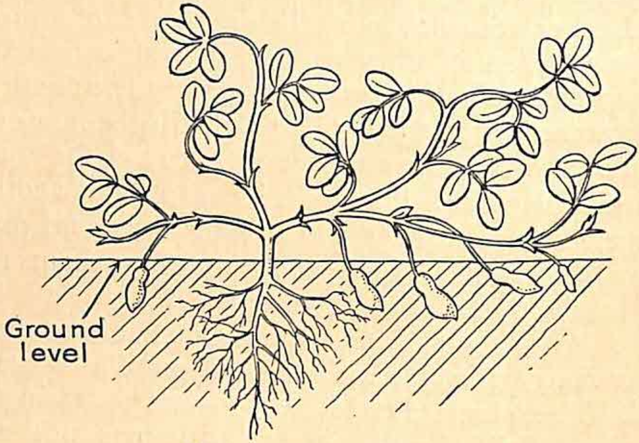

FIG. 2. Ground-nut

9. *Balsams*. These are easy to grow and have flowers very quickly, usually about six weeks after planting the seeds. The colours are white, yellow or pink. One plant should be grown in an eight-inch pot or three in a twelve-inch pot. The whole life of the plant is about three months.

10. *Cannas*. These red and yellow flowers are grown from seeds. After the flowers have died cut off the stems near to the ground and leave the short stems in the soil. In three or four weeks new plants

will be growing. In this way the same plant can give flowers for a very long time.

To avoid moving young plants like tomatoes and brinjal, you may prefer to grow the seeds in a banana leaf container, which can be placed in the ground without transplanting. Also, remember that an old mosquito net is useful in keeping birds off ripe fruit.

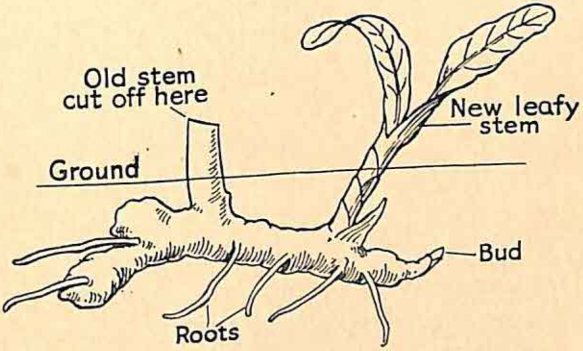

FIG. 3. Canna Lily

The above plants are only a few of the common ones. There are many, many more. Grow as many kinds as you can. Learn their names and learn how to know plants by their leaves, flowers and seeds.

## § 11. GROWING PLANTS WITHOUT SEEDS

Plants can be grown from parts other than seeds. Some can be grown from stems, some from roots, and some from leaves. This should be done in the fourth or fifth primary year.

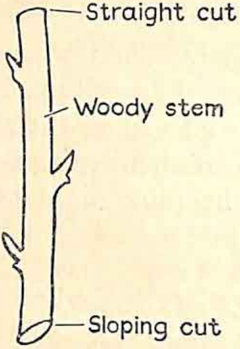

FIG. 4. Hibiscus cutting

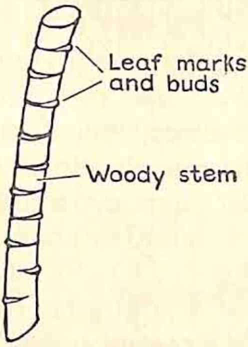

FIG. 5. Cassava (Tapioca) cutting

(*a*) *From stems*

(i) *Hibiscus*. Four common plants which can be grown from stems (called cuttings) are Sweet Potato, Hibiscus, Cassava (Tapioca) and Bougainvillea. Cut off pieces about twelve inches long and half an inch thick from some hard, woody Hibiscus stems. Do not use the soft green stems because there is no food stored inside them on which they can live until roots form. Take off all the leaves from the cuttings, which then look like sticks with lumps on them. If the leaves are left on, the cuttings may lose too much water and die.

Use a stick to make sloping holes two or three inches deep in the soil where you are going to grow the Hibiscus. Put the Hibiscus cuttings in the holes and press the soil around them so that they are held firmly. Be careful to put the cuttings the right way

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up. If the weather is dry, water the cuttings twice a day. Bougainvillea and Cassava are like Hibiscus and grow best from old and woody stems.

(ii) *Cassava or Tapioca.* To grow Cassava (Tapioca), pieces from the middle part of the stems should be planted. The cuttings have no leaves on them and should be about six inches in length. One-half of their length should be covered—if the weather is dry, more of their length should be in the soil. They should be planted about three feet apart and with three feet between rows. Cuttings of Tapioca are like Hibiscus cuttings and look like sticks with lumps on them.

(iii) *Sweet Potato.* Cuttings of Sweet Potato between nine and twelve inches long should be taken from soft, young pieces of stem. Take off the leaves. Put the cuttings in holes about twelve inches apart and bury them to about half their length. It is best if they are grown in banks or beds of soil raised about eighteen inches high. The cuttings need plenty of water. The crop is ready when the leaves begin to die, after about three or four months.

Sweet Potato plants can also be grown from the potatoes themselves. Keep one for two or three weeks without putting it in the soil; you will find that buds form on it. Cut it into pieces with one bud on each and put the pieces in the ground; new plants soon grow.

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### (*b*) *From roots*

Bougainvillea and Breadfruit can be grown easily from pieces of roots. Choose roots that are about as thick as a finger and cut off pieces. Put them the right way up in soil which contains plenty of sand. The tops of the cuttings should be just below the surface of the soil and the cuttings should be put in sloping and not straight up.

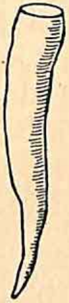


Fig. 6. Cutting of Breadfruit root

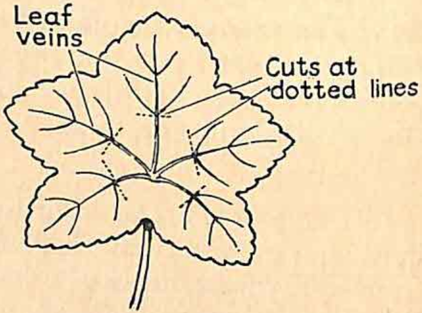


Fig. 7. Cutting of Begonia leaf

### (*c*) *From leaves*

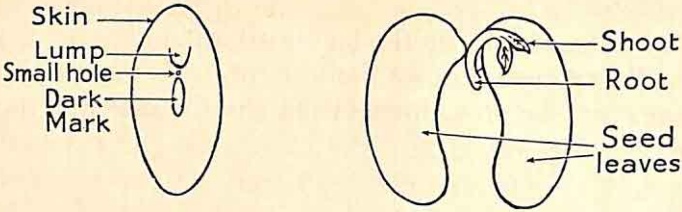
Only a few plants can be grown from leaves. Look at a large Begonia leaf and note the main veins and the smaller veins. Make one cut with a sharp knife or blade across each main vein just below the place where the smaller veins join it. Place the cut leaf flat on some soil in a jar or pot. Put a few small stones on it to keep it in position; if the stalk of the leaf is pushed into the soil it also helps to hold the leaf in place. Put water on the leaf until it is just wet. Too much water will make the leaf rot. After some time roots may begin to form at some of the cuts and new plants to grow.

## § 12. BEAN SEED

A ripe seed is really a very young plant and it has in it a small root, stem and leaves. It also has food which is used by the young plant before its roots are able to take food from the soil. Find out more about seeds (in the third or fourth primary year) by looking at some of them. A good one to start with is a bean seed, such as the Sword Bean, because it is big and therefore easy to open and see the parts inside it.

(i) Look at a bean pod. Look at and feel one dry bean seed. Can you see a dark mark on the seed? By looking at a seed in the pod can you say what caused the mark? (The stalk.) Note a small lump, shaped like a triangle, near one end of the mark. The lump is caused by the little root under the skin. Try to take off the skin of the dry seed. Is it easy to do so? Make drawings of the seed.

(ii) Place some seeds in water and leave them for one day. They become much larger in size and feel softer. Press one of them gently between the fingers. What happens near one end of the black mark on the skin? (Water comes out.) What must there be at that end? (A small hole.)



(a) (b) Seed-leaves opened

FIG. 8. The bean seed

Note the hard, tough skin around the seed. Use a pin to take it off without breaking the rest of the seed. Inside it are two large yellowish-white seed-leaves; they are used as food by the plant when it starts to grow and they keep it alive until the roots are strong. Can you see the root without opening the seed-leaves? Open the two seed-leaves carefully. Look at the young seed-plant inside—it has a root, a short stem and very small leaves. What colour are these leaves? Inside the leaves is a very small bud. Make large clear drawings of all you have seen.

## § 13. MAIZE SEED

(i) Look at a dry maize seed. Note the mark where the seed was fastened to the maize fruit (cob) and also note the light-coloured part shaped like a shield. The seed plant lies under this part. Draw the seed.

(ii) Place a maize seed in water for a day. You will find that you cannot open it into two parts like the bean seed, so use a sharp knife to cut it in two down the middle of one of its flat broad sides. Use a reading glass or a magnifying glass or lens (which make things look bigger than they really are) and try to see the seed-leaf, the seed-shoot and the seed-root. There is only one seed-leaf, not two as in the bean seed. The shoot is a number of very small leaves wrapped around one another, with the young bud inside. Note the yellow and white foods outside the baby plant. Draw what you see.

(iii) Take another maize seed which has been in water for one day or more. Cut through the seed down the middle of the light-coloured part and through part of the seed-leaf. Pull the cut parts open gently and use two pins to take out the seed-plant. Look at the seed-plant through a reading glass.

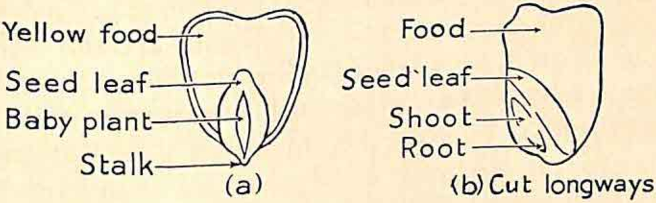


FIG. 9. The maize seed

## § 14. OTHER SEEDS

Look at some other seeds which are like the bean seed (e.g. ground-nut, cow pea, rubber, sunflower) and some like the maize seed (e.g. rice, millet, sorghum).

(i) Note the colour of the skin of a ground-nut. What is the colour when the nut is young? (White.) What is the colour when the nut is ripe? (Pink.) Inside the skin are two white seed-leaves and a small root. Open the seed-leaves. Can you see the shoot?

(ii) Look at a dry rice seed and also at one which has been in water for some time. Try to see all the parts of it. The seed is very much like the maize seed. Make drawings of what you see. Cut in two a grain of brown rice (after it has been in water for a day). Note the very small baby plant. Do the same with a grain of polished rice. Can you see the baby plant? (No.)

## § 15. HOW TO WATCH SEEDS GROW

Find a jar or bottle with a wide top, at least two inches wide; if your school has science equipment use either a glass beaker or a gas jar. Put some blotting-paper inside the jar so that it touches the glass all round. Fill with sand, sawdust, or small pieces of coconut fibre. Put the seeds between the glass and the paper. Place them half-way down the jar and do not put more than four or five seeds in one jar. Add some water until the sand, sawdust or fibre is wet and the blotting-paper is damp. There should be no water on the bottom of the jar.

At first keep the seeds in a dark cupboard. As soon as the shoots come out put them in the light. Do not put them in hot sunshine or the plants will

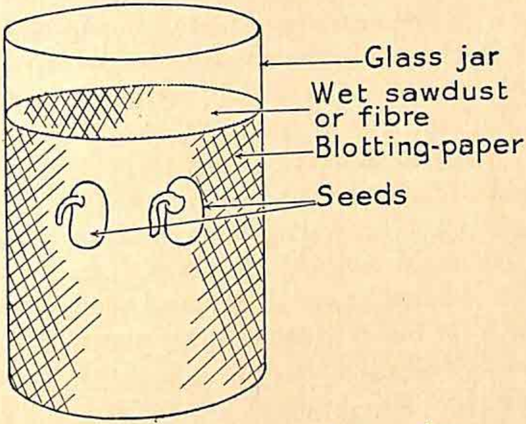


FIG. 10. Growing seeds in a glass

die. Make sure that the blotting-paper is always wet by adding a little water every day.

A seed with a white or grey "fur" on it has caught a disease; throw it away. When you go home from school put the jars in a cupboard or in a big box so that rats or cockroaches cannot find the plants and eat them. Ants will also eat them if they can.

## § 16. HOW A BEAN SEED GROWS

Grow some bean or cow pea seeds in jars as described above. Put one seed in every day; at the end of a week you have seeds just starting to grow and seeds which have grown a lot. Note what happens as they grow.

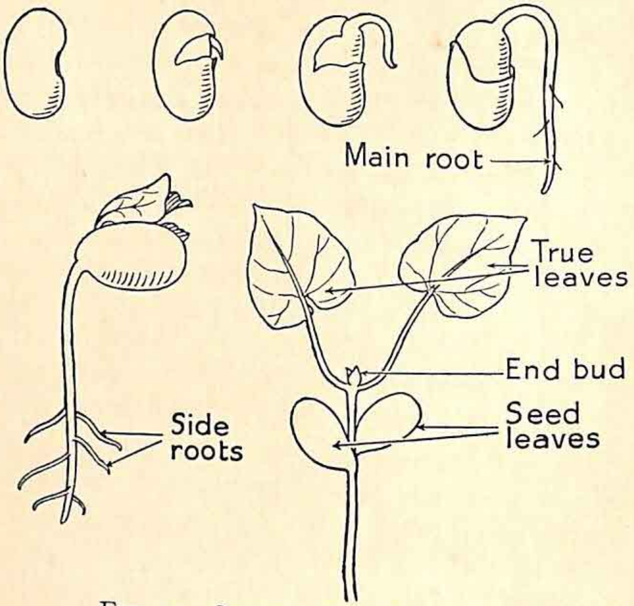


FIG. 11. Growth of the bean seed

The skin of the seed first breaks near the dark mark, at the end where there is a hole in the skin. The roots grow first so that they can hold the seeds in the soil and also get water and food for the growing plants. No matter how the seed is put in the soil the root always grows down. Near the end of a root are little white hairs called root-hairs. Do they grow right at the end of the root? (No.) Do they grow all along the root or only in some parts? (Only near the end.) After a time other roots grow. Do they grow out of the seed or out of the first root? (From the first root.) Do they grow as long as the first root, and do they grow as thick as that one? (No.) Are there any root-hairs on these side roots? (Yes.)

The two seed-leaves press on the skin of the seed, tear it, and the skin falls off. The two leaves open and the shoot grows between them. The small leaves of the shoot open and turn green in the light. When sword beans are grown in soil the parts of the seed which first come above the ground are the seed-leaves. They turn green in light and are quite different from the true leaves which grow later. They soon drop off. They cover the shoot as it comes through the soil and save it from being damaged.

The seed-leaves of all plants do not come above the ground in this way, e.g., those of cow pea and castor-oil seed do, but those of ground-nut and sunflower do not.

## § 17. MORE THINGS TO DO WITH SEEDS

(i) *To find how a maize seed grows.* Grow some maize seeds in jars. The root grows first and it comes out of the middle of the light-coloured mark on the seed. Do any root-hairs grow on this root? (Yes.) After a time new roots grow. Do they grow out of the seed itself or out of the first root? (Out of the seed.) Do they grow as long and as thick as the first root? (Yes.) Are the roots of maize the same as those of the bean in these ways? (No.)

The seed-shoot breaks through the skin of the seed in the light-coloured part. The end of the shoot is pointed so that it can easily push its way

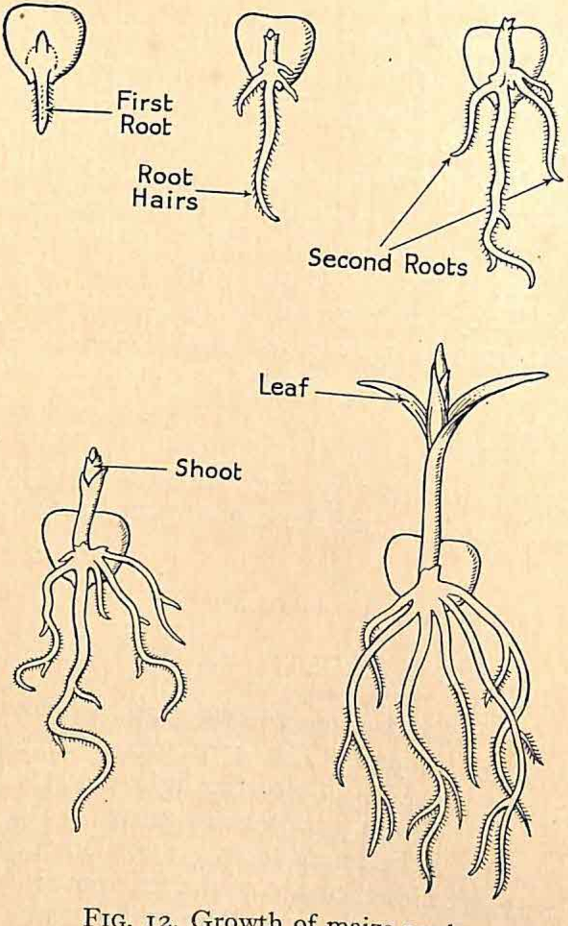


FIG. 12. Growth of maize seed

through soil; it is also covered with a white skin so that the young plant is not damaged by the soil. A green leaf breaks through this white skin and starts to open.

(ii) *To find how a rice seed grows.* Try to grow rice seeds in jars (do not use polished white rice). As the seeds are very small you may find that they grow better if they are just placed on some wet cotton-wool or sawdust on a plate or tin lid. Note all the changes which take place as the seeds grow.

(iii) *Do seeds need water before they can grow*? Put some dry seeds on some dry sawdust or dry cotton-wool in a glass. Put other seeds on some wet sawdust or cotton-wool. Leave them for three or four days. Which seeds grow? What does this show? (Seeds need water.)

(iv) *Do seeds need air before they grow*? Take two glass tubes. In one put some wet sawdust or cotton-wool. Boil some water until there is no air left in it, let it cool, and then put it in the second tube. Place two seeds in each tube. Cover the water with about one quarter of an inch of coconut oil so that no air can reach the seeds in the water. Leave for three or four days. Which seeds grow? What does this show? (Seeds need air.)

(v) *Is the food in a seed needed when a seed grows*? Take two young bean or cow pea plants growing in pots. Cut off the seed-leaves of one of them as soon as they come out of the soil. Leave the plants for a few days. Which plant grows better? What does this show?

(vi) *Do the leaves of a plant help it to grow well*? Grow two young bean plants in pots. Cut off the green leaves of one of them as soon as they start to grow. Leave the plants for a few days. Can you see any difference between the plant with leaves and the plant without leaves? Which plant grows better? What does this show?

(vii) *What is the effect of light on the growth of plants*? Plant some maize or bean seeds in two pots. Place one pot in a dark cupboard and the other one in the light. Compare the plants after one week. What do you find? What does this show? (In the dark the plant is white or yellow, long and thin, and has small yellow leaves.)

(viii) *What is the effect of light on the stem and leaves*? Take a pot in which there is a plant with leaves on it. Put the pot near a window for one or two days. What happens to the stem and the leaves on the plant? (The stem bends towards the light.) Turn the pot half-way round. What happens to the stem and leaves after one or two more days? (It bends again towards the light.)

## § 18. COLLECTING LEAVES AND FLOWERS

Roots, stems, bark, fruits and seeds are easy to keep. If you want to keep leaves and flowers, however, you must dry them in a press first or they will shrivel and not look nice. To do this, place a piece of blotting-paper or newspaper on a flat surface such as a piece of wood. Put the leaves and flowers on the paper and cover them with a second sheet of blotting-paper. Keep the leaves and flowers flat by putting a few pieces of wood or bamboo about an inch wide on top of the paper. Put the whole thing in the sun until they are quite dry.

When you put flowers in a press, place the petals so that you can see inside the flowers. Some parts of plants are thick and fleshy and would take a long time to dry. Dip these parts in boiling water for a minute or so in order to kill them, and then they will dry quickly when in the press.

Gum the dry leaves and flowers on white cardboard or the pages of a book. It is best to stick small pieces of gummed paper over the stalk and a few other parts. They are then easy to remove when you wish to do so. Write the name and date under each specimen. Put all the specimens in bright sunshine for about half an hour each week so that they do not go bad; sunshine kills germs that would destroy the specimens.

## § 19. MORE THINGS TO DO

(i) *To find out if there is air in a leaf.* Put a Hibiscus leaf into some very hot water in a glass jar. Watch the surface of the leaf. What do you see forming at various parts of the surface? (Air bubbles.) This shows there are tiny holes in the leaf. Which surface, the upper or lower, of the leaf has more holes in it? (Lower.) Leaves take in air through these holes and send out other gases.

(ii) *To look at the roots and veins of some plants.* Look at the roots of plants, for example, maize, millet, bean, pea, rice, grass, bamboo, balsam tomato, and so on. Name the plants which have a large main root (tap root) and many smaller side-roots (bean, pea, balsam, tomato). Name the plants whose roots are all about the same size (maize, millet, rice, bamboo, grass). Look at the veins on the leaves. Which of the plants have leaves with veins that run almost parallel in one direction? Which of the plants have veins that spread over the leaf like a spider's web or a net? Look at your answers to all these questions. The plants with one kind of roots also have leaves with one kind of vein.

(iii) *To look at root-hairs on a plant.* Grow several mustard seeds on a damp black cloth. Scatter the seeds in a thin layer over the cloth and then roll it up loosely. After a few days unroll the cloth and look at the seeds. Note the white hairs near the tips of the roots—they show up well against the dark cloth. A second way is to grow some seeds in a glass lined inside with dark paper instead of the usual blotting-paper. After two or three days the white root-hairs can easily be seen.

(iv) *To find out what is inside a bulb.* Take one bulb of a Crinum Lily (White Lily or Spider Lily) or onion or leek. Pull out one of the green sword-shaped leaves growing in the bulb, breaking it off near the bottom of the bulb. What colour is the part of the leaf which was in the bulb? (White.) Cut the bulb right through the middle from top to bottom; look at the cut parts and note all you can. Look at the dry leaves on the outside, the thick, juicy, fleshy leaves full of food inside, and the short, thick stem near the bottom of the bulb. Look at the many roots at the bottom of the stem. What colour are the roots? Are all the roots about the same thickness or is there one main root?

(v) *To find out how things pass through the roots of plants.* Take a young balsam or papaya (pawpaw) plant out of the soil carefully so that its root-hairs are not broken, and wash the roots. Place the plant with its roots in some red ink and leave it for one or two hours. Do the leaves and flowers change colour, and can you see any red parts come on them? (Yes.) Cut across the stem and also across the main root and look at the cut parts. Can you see any red on them? (Yes.) What does this show?

Do the same thing once again, but this time put the plant into water mixed with red chalk. Are the results with chalk the same as those with red ink? (No.)

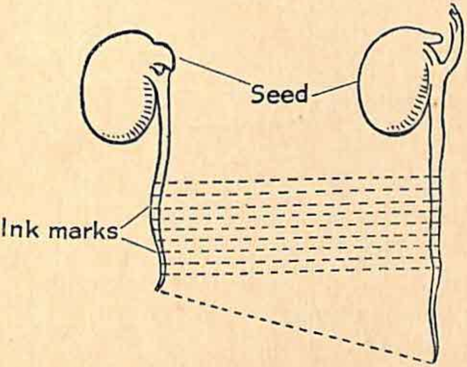


FIG. 13. Which part of a root grows?

(vi) *To find out which part of a root grows.* Grow some bean seeds in a glass. When the roots are about an inch long choose one seed with a straight root. Dip the middle of a piece of thread, about six inches long, in Indian ink. Hold the thread tightly by its ends and make marks on the root, starting from the end. Make seven or eight marks about one-tenth of an inch apart. Put the marked seed back in the glass and let it grow. Look at it every day. Which marks become wider apart? (Those near the end.) What does this show about the part of the root which grows?

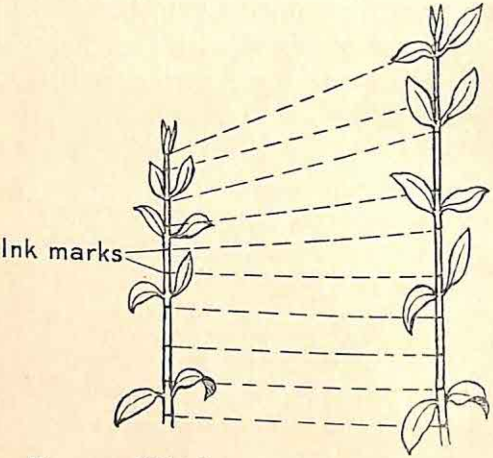


FIG. 14. Which part of a stem grows?

(vii) *To find out which part of a stem grows.* Take a balsam plant growing in a pot and mark its stem with Indian ink in the same way as you marked the ot in number (vi) above. This time make the marks about one-quarter of an inch apart. Let the plant grow for a few days. Do any of the marks grow wider apart than others do, or do all parts of the stem grow the same amount? (Most parts of a young stem grow.)

Numbers (i) to (iv) above are suitable things to do in the third or fourth primary year; the others are suitable only for the top classes of primary schools.

## *PART III*

# THINGS TO DO WITH TREES, FLOWERS AND FRUITS

### § 20. TREES

Take the whole class some distance from the tree being studied and let the children observe its appearance, shape and form. Next, go near the tree and let them talk about it in a general way, avoiding details as far as you can. Stimulate discussion by asking leading questions such as: Is the wood useful? Can the fruit be eaten? Are there local stories about this tree or this kind of tree? Has anyone seen this kind of tree elsewhere in the district or State? After this introduction, add any suitable information known to you.

In the first lesson do not examine in detail its bark, trunk, etc. Treat each one of these in a later lesson or lessons. Wait until the leaves and flowers are on the tree and repeat the visit to see them. One visit to any tree is not enough. Two or three visits are needed and they should be arranged at times when there is something new to be seen on the tree or when some change is taking place.

In this chapter many tropical and sub-tropical trees and flowers are given as examples. Of course, all of these do not grow in every country or district, but one or two are likely to do so. Keen teachers will soon find plenty of trees and flowers growing in their own district to use as examples.

### (i) Shapes of Trees

First, look at the shape of the tree you are studying. Is it round and bushy (e.g., Mango, Rose of India or Queen Flower) or is it higher than it is wide? The tops of some trees are flat and the trees look like umbrellas (Acacia or Thorn Tree, Umbrella Tree, Rain Tree, Flamboyant).

### (ii) Tree Trunks

Some trees have tall trunks that reach right to the tops of the trees (Kapok or White Silk Cotton, young Durian trees, Pawpaw, Cedar, Eucalyptus, Podo) and the trunks are thickest at the bottom and usually grow thicker every year. Most trees have trunks that divide into several branches (Tulip Tree or Nandi Flame, Flamboyant, Indian Laburnum, Rose of India or Queen Flower, Umbrella Tree, Red Hot Poker Tree or Uganda Coral).

Note the bark on trees. What is its colour, is it rough or smooth, are there cracks or long holes in it, does it pull off easily? Cut the bark of a Hibiscus tree with a knife and then try to pull off a piece. What happens?

### (iii) Leaves

Note their shapes, if they are thick or thin, large or small, smooth or hairy, shiny or dull. Some of

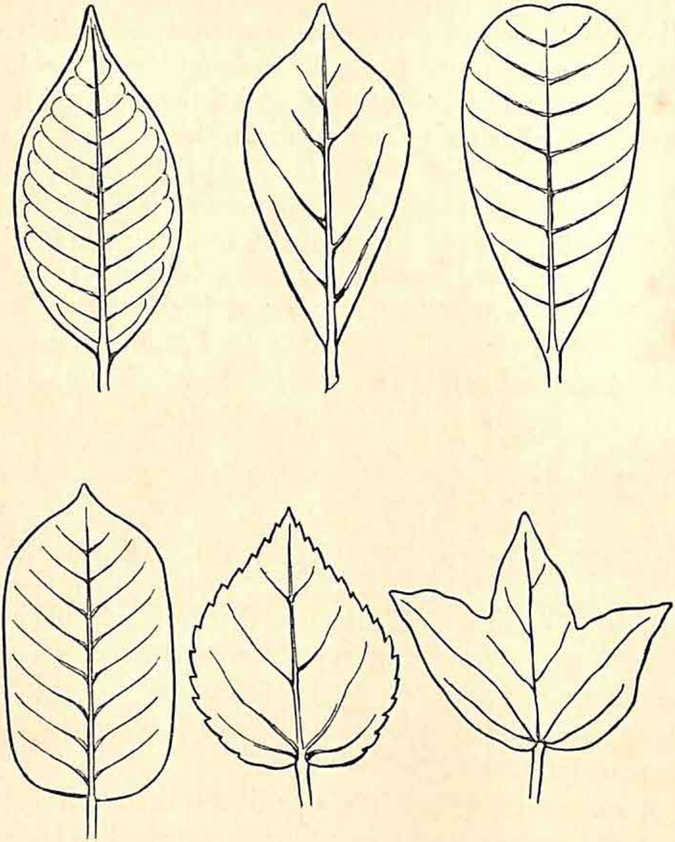
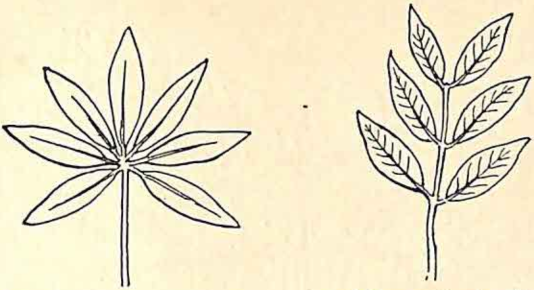
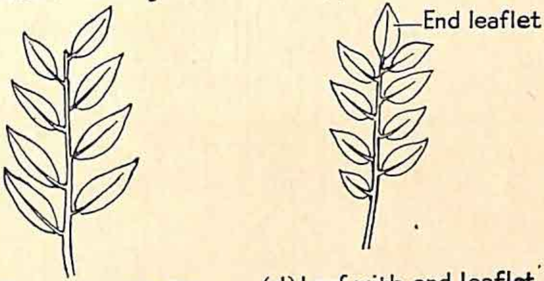


FIG. 15. Shapes of leaves

the leaves are long and narrow, some are broadest in the middle, some are shaped like an egg and some like a heart. Make two columns in the Nature Study diary. In one column draw all the different shapes of leaves which you find. In the other write down



(a) Leaflets like fingers (b) Opposite leaflets



(c) Leaflets not opposite (d) Leaf with end leaflet

FIG. 16. Leaves with leaflets

the names of the trees which have leaves of these shapes.

A true leaf always has a bud where it joins the stem. Hibiscus, Frangipanni, Allamanda, Oleander, Kenya Greenheart, Iroko or Mvule, and Bougainvillea have simple leaves, i.e. there is only one leaf on a stalk. Leaves of Morning Glory and Pawpaw (Papaya) have parts just like the fingers on a hand (finger-like leaves). Look at the leaves of Jacaranda, Rose of India, Tulip Tree or Nandi Flame, Pride of Barbados or Peacock Flower, Cassia, Ironwood, and

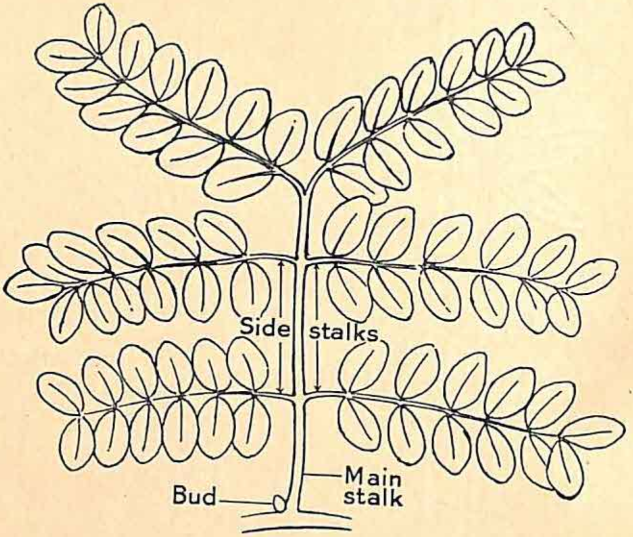
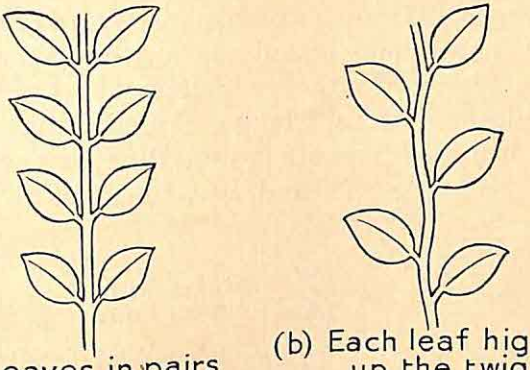


FIG. 17. Leaf with side-stalks

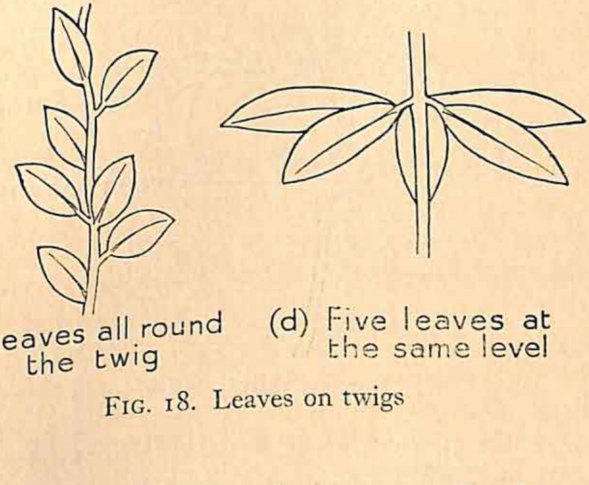
Yellow Flame. None of these leaves is a simple leaf. Some have rows of leaflets on both sides of the common stalk; on others, the main stalk has several side-stalks on each side of it and the leaflets are on the side-stalks, e.g. Acacia or Thorn Tree, Rain Tree, Jacaranda. These leaves are called feather-like leaves. Sometimes the leaflets are opposite each other and sometimes they are not. Some leaves have a leaflet at the end of the stalk and others have no end leaflet. The diagrams show what these leaves look like.

### (iv) How Leaves form on Twigs

Collect twigs of many trees. Note how the leaves are placed so that each one can get light from the



(a) Leaves in pairs (b) Each leaf higher up the twig



(c) Leaves all round the twig (d) Five leaves at the same level

FIG. 18. Leaves on twigs

sun and does not cast a shadow on other leaves. The leaves are formed on the twigs in four ways. First, the leaves are in pairs; examples: Coffee, Eucalyptus, Tulip Tree or Nandi Flame, Mangosteen, Ixora. Second, each leaf is higher up the twig than the one before and is on the opposite side of the twig so that there are two rows of leaves; examples: Acacia, Ironwood, Durian. Third, the leaves are all round the twig and not in two rows, and each leaf is higher up the twig than the one before; examples: Hibiscus, Mango, Frangipanni. Fourth, three or more leaves are around the twig at the same level; examples: Oleander, Allamanda.

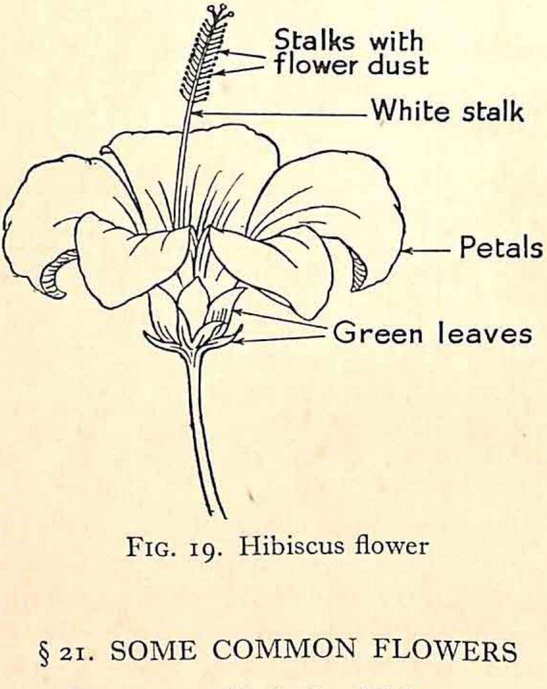


FIG. 19. Hibiscus flower

## § 21. SOME COMMON FLOWERS

All the flowers studied should be grown in the school garden or grounds, and they should be planted sufficiently far ahead to be ready when required. If the flowers are in the school compound, the first lesson should include a visit to see them growing.

Hibiscus, Crinum Lily (White Lily or Spider Lily), Red Lily, Gloriosa Lily (Climbing Lily), Periwinkle, and Allamanda are good flowers to look at because they are so big. Hibiscus and Allamanda do not form seeds in many countries, however. Every child should have his own flowers if the lessons are given in the classroom.

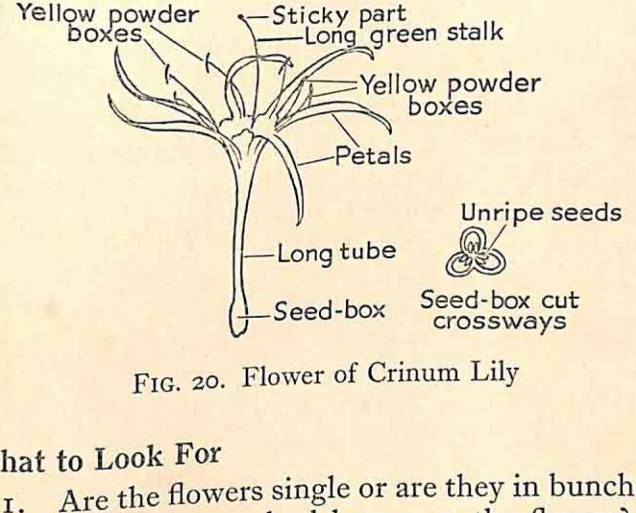


FIG. 20. Flower of Crinum Lily

## What to Look For

1. Are the flowers single or are they in bunches?

2. Are there any bud-leaves on the flower? If so, how many, and what is their shape and colour? Are these leaves separate or are they joined together? Are the leaves in one ring or more than one?

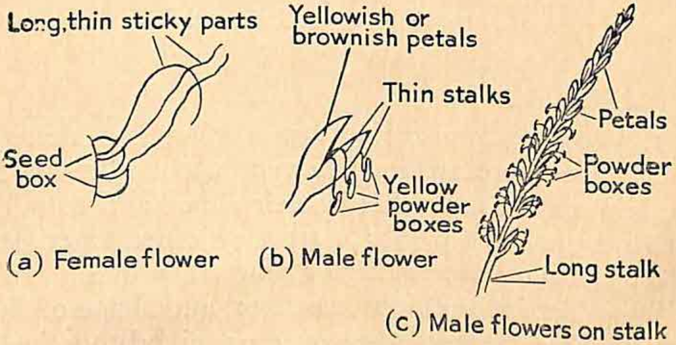
3. What is the colour, number, and shape of the petals? Are the petals separate or joined together? If they are joined, what shape do they take, for

example, bell, cup, tube, and so on? Are all the petals the same (in some flowers one petal has a different colour or different shape from the others)? Are the petals in one ring or in more than one.

4. Are there any heads or boxes of yellow powder (pollen), and, if so, how many? Are the stalks holding the powder all the same length or are some longer than others? Are the heads arranged in rings?

5. Are there any sticky parts (stigma) and, if so, how many? What is their colour? What is their shape? Is the stalk holding the sticky parts long or short?

6. How many rooms are there in the seed-box (ovary)? How many seeds are there in one room? What is the colour of the seed-box with the unripe seeds? What colour is it when the seeds are ripe? What is the colour, size and shape of the ripe seeds?



(a) Female flower (b) Male flower

(c) Male flowers on stalk

FIG. 21. Maize flowers

## § 22. PLANTS WITH TWO KINDS OF FLOWER

A Maize plant always has two different kinds of flowers on it. The Coconut palm and Rubber tree are like Maize—they have two kinds of flowers and both kinds are on one plant. The Papaya (Pawpaw) also has two kinds of flowers, but any Papaya tree only has one of the kinds on it. Thus one Papaya tree may have flowers with flower-dust, while another tree may have flowers with seed-box and sticky parts, but with no yellow powder. One tree by itself cannot form seeds.

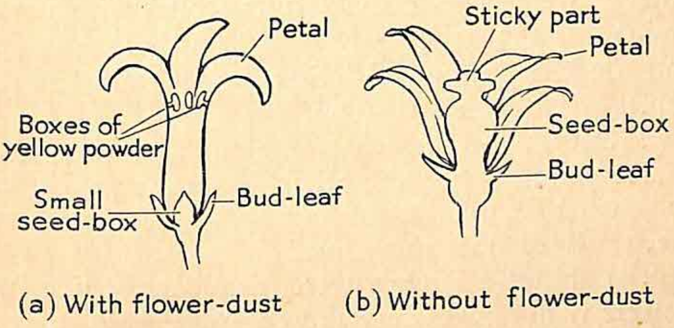


FIG. 22. Papaya flowers

## § 23. MORE THINGS TO DO WITH FLOWERS

1. Take some yellow flower-dust from different kinds of flowers and look at it through a strong reading glass. Do all the kinds of dust look the same? (No.)

2. Try to find some sweet, sugary liquid in flowers. Usually it is at the bottom of the petals and

near the seed-box. Note if insects are likely to touch the yellow flower-dust when they try to reach the liquid.

3. Watch one Hibiscus flower on a tree. How long does it stay open before its petals die and drop off? How long is it before the rest of the flower falls? Look at the flower stalk and try to find what part of the stalk breaks to let the flower fall. Does the Hibiscus form ripe seeds?

4. Tie a cloth bag round the threads which hang from one of the flowers on a Maize plant. When the other flowers have formed fruits (cobs) with many grains in them, what do you find on the one which had the bag around it? (Few or no grains in the cob.) What does this show?

5. Cut off the threads of one of the flowers on a Maize plant. When the other flowers have formed cobs what is this flower like? Does it have any seeds? What does this show?

6. Look at a Papaya tree. Find one which has flowers with flower-dust and one which has flowers with a seed-box, unripe seeds and sticky parts. Make drawings of the flowers.

## § 24. HOW PLANTS SEND AWAY THEIR SEEDS

Several kinds of seeds are thrown away from the parent plant when the fruits open quickly. When a Balsam fruit is ripe, it opens very quickly and throws out the seeds if you touch it with your fingers. The Rubber tree has fruits which do the same. Inside one of its fruits are three rooms, and there is a hard woody part around them. On hot days when the air is dry the woody part splits open and the seeds come out.

### How Fruits and Seeds are Moved by Wind

Wind moves the ripe seeds away from many parent plants. Some seeds, for example, seeds of grasses, are so light and small that they can easily be blown by the wind a long way from the parent. Some other fruits or seeds have a special part which is just like a wing. As such a fruit or seed falls, the wing helps to keep it up in the air for some time. In this time the wind carries the fruit or seed much farther than it would if there was no wing on it.

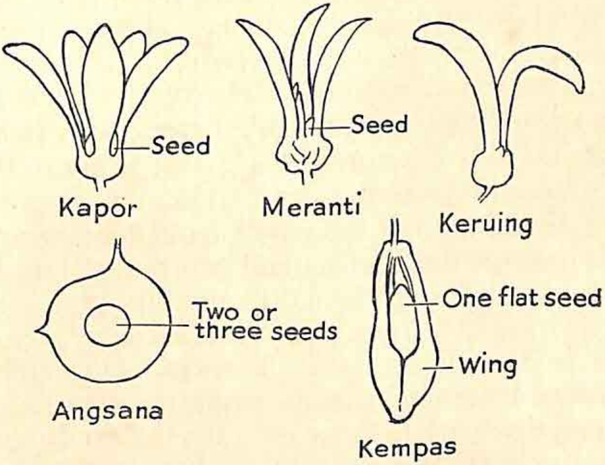


FIG. 23. Fruits with wings

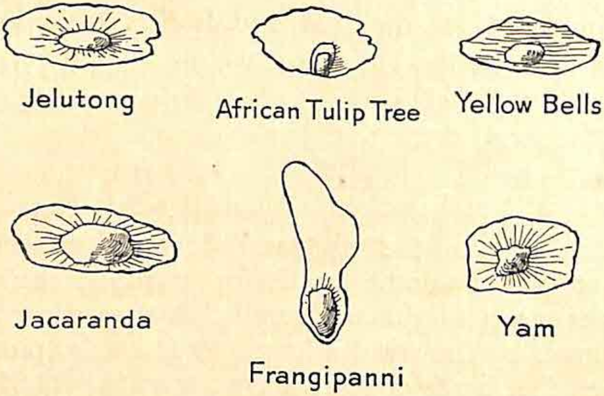


FIG. 24. Seeds with wings

Also, even when the fruit or seed is on the ground the wind may still blow it along.

Kapor, Meranti, Keruing, Angsana, Ironwood, Markhamia and Kempas are trees which have fruit with wings. In some other trees, for example, African Tulip Tree or Nandi Flame, Yellow Bells, Flamboyant, Jacaranda and Jelutong, the seeds themselves, and not the whole fruit, have wings.

Kapok, Cotton, Lalang and Morning Glory have seeds with hairs on them. The wind blows against the hairs and carries away the seeds, which can float in the air for long distances. Oleander has fruits which contain seeds with very fine hairs on them—the hairs help to keep up the seeds so that they can float. Some grass seeds have stiff hard hairs or hooks on them so that they can stick to cloth or to the hairs on the legs and bodies of animals. When they do this the seeds may be carried very far from the parent plants.

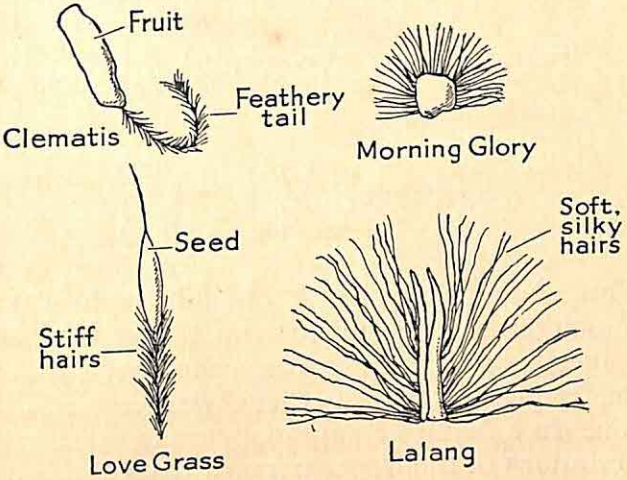


FIG. 25. Seeds with hairs

# *PART IV*

# THINGS TO DO WITH BIRDS

## § 25. KNOWING COMMON BIRDS

You should learn to know fifteen to twenty common birds when you see them, that is, birds such as pigeons and doves, swifts, sparrows, swallows, owls, kingfishers, woodpeckers, weaver birds, and so on. In a Nature Study diary make a list giving descriptions of the upper parts, throats and breasts of these birds. When the children are watching birds let them write down the following things about them:

1. Where you saw it. In the garden? In fields? On the edge of the jungle? On the ground? High in the trees?
2. How many birds there were. One? Two? Many?
3. The colour of its head, neck, back, tail.
4. Its size. As big as a Sparrow? As big as a Pigeon?
5. Its calls. Short or long? High or low? Has it a tune? Is the tune repeated?
6. The shapes of its body, tail, beak.

7. The shape of the wings.
8. The movement in flying.
9. The movements on the ground.

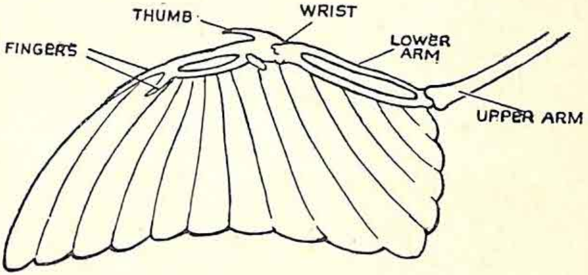


FIG. 26. Wing of a bird

## § 26. A BIRD'S BODY AND FEATHERS

Some things to do in the fourth or fifth primary year are:

(i) Look at a pigeon carefully. If there is no pigeon, use some bird that is kept in a cage. Is the beak hard? (It is hard, narrow and slightly curved at the end.) Does the bird have teeth? (No.) How do the eyes of a bird differ from your eyes? (The eyes can be moved separately; a pigeon can see on both sides without turning its head, as we have to do.) Does the bird have eyelids? (It has an upper eyelid, lower eyelid, and a white, thin, third eyelid which is often used to wipe its eyes clean.) What can you see on the head just behind the eyes? (The ears, which are two small holes.) How many toes has it? (Four slightly curved toes, three in front and one behind.)

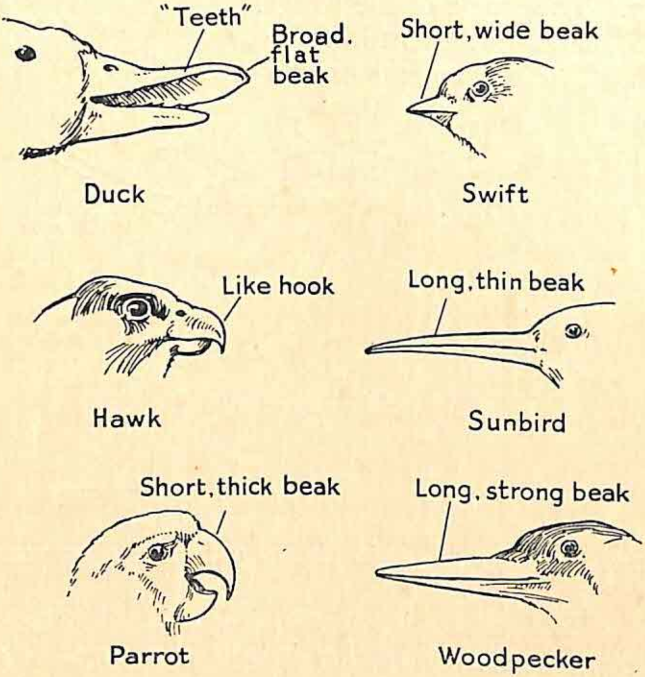


FIG. 27. Beaks of birds

(ii) Collect feathers of some birds. Pin them or tie them to a piece of wood or cardboard. Put a name on each feather.

(iii) Show the three kinds of feathers: the long "quill" feathers in wings and tail; the smaller "body" feathers, and the soft fluffy "down" feathers on the breast and on very young birds. Pour some water on a feather; what happens? Wash a feather well with soap to remove the oil on it and then pour water on it; the feather is easily made

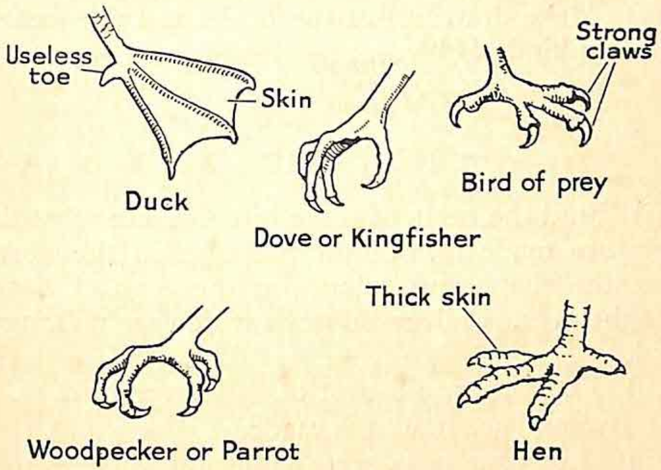


FIG. 28. Feet of birds

wet. Look at a feather through a reading glass; what do you see? Is the stem of a feather hollow or solid? (A feather consists of a broad blade spreading from a central shaft and ends at the bottom in a hollow stem. The blade is made of many things, each like a tiny feather, which hook on to one another to form a strong, light, elastic blade. If they come apart, the bird just shakes itself and draws its beak over them to join them together again. Note that the two halves of the blade are not the same size.)

(iv) Collect all the bones from one chicken or from one bird. Tie them to wood or cardboard and put a name on each bone. Compare the bones in the wing of the bird with the bones in your shoulder, upper arm, lower arm and hand. How many bones are there in the "hand" of a bird?

(v) Make drawings of the beaks and the feet of different kinds of birds.

## § 27. NESTS AND EGGS

(i) Find the nests of some birds. Note what the nests are made of. Count the eggs in the nests. Note the shape and colours of the eggs. Do not take the eggs. Collect old nests which are no longer used.

(ii) Look at an old nest of a Weaver bird. Cut it in two and see how it is made.

(iii) Let your class see a collection of eggs in a good museum, if one is near. If there is a collection of eggs in the school let the children make paintings of them.

# *PART V*

# THINGS TO DO WITH AN AQUARIUM

## § 28. AN AQUARIUM

An aquarium is a home for water animals and water plants. It should have a large surface of water for air to enter. An aquarium which is deep and narrow is not good. A rectangular tank is best. A good size for an aquarium is eighteen inches long, twelve inches wide and twelve inches high. If such a tank is too dear to buy, a cheaper aquarium is easily made from one of the large glass bottles used for rubber acid or battery acid. Take the bottle to a shop where part of the top can be cut away to leave an opening about twelve inches wide.

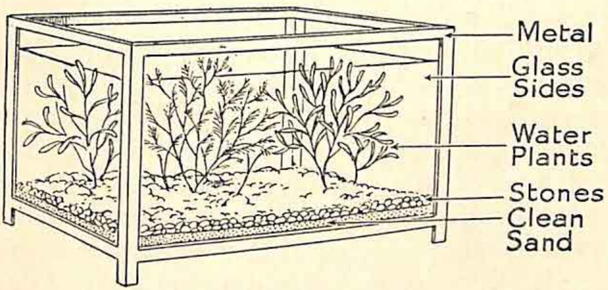


FIG. 29. Aquarium

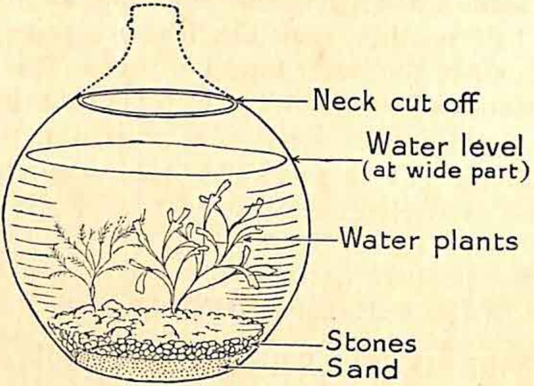


FIG. 30. Aquarium made from rubber acid bottle

## § 29. FILLING THE AQUARIUM

Wash some sand until it is quite clean and put it at the bottom of your tank. The sand should be about two inches deep. Put a few coloured stones in the sand, as fish like to play among them. Find some small green water plants which grow under water and not on the surface, and put their roots in the sand. If the plants have no roots, put the end of the stem in the sand; the roots will soon grow.

Pour water into the tank very slowly or use the way described in section 31 below. Leave the aquarium until all the sand has gone to the bottom and the water is quite clear. Place it near a window where it will get several hours' light every day but little direct sunshine.

Put some small fish in the tank. Do not put in too many fish or they may die because there is not enough air in the water for all of them. It is best to have twenty square inches of water surface for a fish about three inches long. An aquarium eighteen inches long and twelve inches wide can therefore hold ten or twelve such fish.

## § 30. FISH FOOD

Feed the fish once every two days and do not give them too much. Take away any food they do not eat ten minutes after you put it in. Food left in the water goes bad and soon kills the fish. Worms, meat or freshly killed flies cut into very small pieces are good food. Fish also like ants' eggs or plain biscuit (e.g. dog biscuit) cut into small pieces. Some shops sell small pink worms which are also good. Rice and bread are not food for fish and must not be given.

## § 31. CHANGING THE WATER

The water need not be changed often; once every two or three weeks should be enough. If the water turns green in colour or has a bad smell or if the fish come to the top and open and close their mouths, the water must be changed at once. Use a rubber tube about three feet long to do this. Put it in the aquarium gently so that it fills with water and has no air in it. Close one end tightly with your fingers. Lift out this end and let it hang down into a pail or sink, which must be lower than the aquarium. Leave the other end of the tube in the water. Take your fingers off the end of the tube and the water will run into the pail; if it does not run there is probably air in the tube. A rubber tube used in this way is called a siphon.

To fill the aquarium again with water it is best to siphon it from a pail placed higher than the tank. The water goes in gently and does not move the sand and plants. If the sides of the tank are covered with dirt or a green slime, clean them with a cloth. Four or five fresh-water snails will help to keep an aquarium clean. They eat the green stuff that forms on the sides.

## § 32. SEA-WATER AQUARIUM

The aquarium you have just made is a fresh-water aquarium. It is good to have a sea-water aquarium also if you live near the sea. It is made in the same way with sand, stones and sea-water. In the tank put small crabs and small fish from the sea. Feed them on very small pieces of meat and take out any food which they do not eat quickly. Water plants will not grow in sea-water so you must change the water once every week if you cannot find the little seaweeds that grow on coral and will live in sea-water.

# *PART VI*

# THINGS TO DO WITH INSECTS AND ANIMALS

## § 33. INSECT AND ANIMAL CAGES

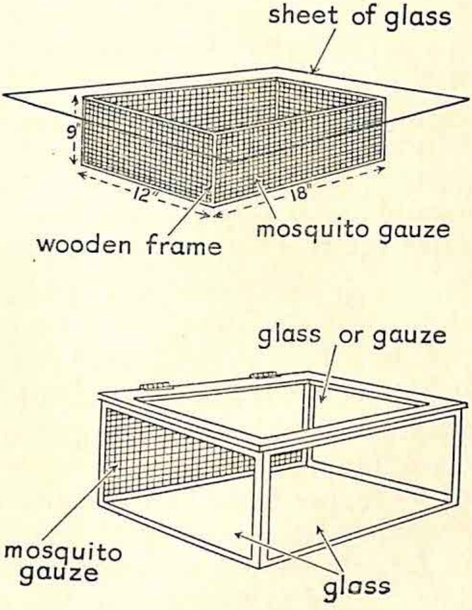


FIG. 31. Insect and Animal Cages

Live insects and animals can be looked at in a small cage. Make a wooden frame and cover the sides with mosquito netting or wire-gauze. Leave the bottom open and cover the top with a sheet of glass or with a loose wooden board. Wire-gauze is better than netting because insects like cockroaches can soon eat holes in netting and animals like geckoes can soon find a way out.

The second cage in the diagram (Fig. 31) is a better one. The top is a lid, hinged at the back, so that animals can be put in and taken out easily.

## § 34. LEARNING ABOUT INSECTS AND ANIMALS

When a class starts to study a living creature, always let them see it in one of these cages and note everything they can about it. Afterwards, do as much practical work as you can. Below are two examples of work that can be done on spiders and snails.

### Things to do with Spiders

1. Watch how a spider makes a web and how it mends a broken web.
2. Look for four or five different kinds of spiders' webs in the house, classroom or garden.
3. Look for cobwebs in the corners or dark places of a building. Try to find an egg-bag on one of them.

4. Find a web that has threads coming from the centre, like spokes from the centre of a bicycle wheel. Touch these spoke threads with a small piece of wood. Are they sticky? Are any of the other threads sticky? Look at a web through a reading glass and try to see threads which have sticky liquid on them.

### Things to do with Snails

1. Keep some snails in a cage with damp soil on the bottom. Give them fresh leaves every day. Can you hear them as they eat? Watch a snail as it moves; how does it feel its way? Touch one and watch it go inside its shell. Which part goes in first and which part last? Watch a snail come out of its shell; which part comes out first? What is on a snail's head? What does it do with them if you touch them with a small stick?

2. Let a snail walk on a stone or concrete floor. Can you see anything on the floor after the snail has passed over it?

3. Find as many different snails' shells as you can. Are they rough or smooth, shiny or dull? What colours are they? Are they heavy or light? Can you break one easily? Cut one shell in two by using a saw. What do you see? Try to find a shell that looks as if it has been broken and then mended by the snail.

4. Your snails may lay round, white eggs in the soil or under leaves in your cage. Watch them every day until the baby snails are born.

The above examples show how to find out things about insects and animals by doing practical work. It is not possible to give details of such work for all living things you will study. There are good descriptions of practical work in the six small books in the series called *Friends and Enemies in the Garden* by Gwen Cross (Longmans). The books are on: (1) Mason Wasps; (2) The Earthworm; (3) The Toad; (4) Caterpillars, Moths and Butterflies; (5) Termites; and (6) Mosquitoes. If you teach these living things in the way the books describe, you will be following a good method. Teach other living things in exactly the same kind of way.

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